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Forest Pest Management
Pacific Northwest Region

ROOT DISEASE SURVEY

GRAY FOX SALE

WARM SPRINGS INDIAN RESERVATION

Root Disease Survey, Gray Fox Sale, Warm Springs Indian Reservation

By

Donald J. Goheen
Forest Pest Management
State and Private Forestry
Portland, Oregon

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INTRODUCTION

During the week of August 25, 1981, a disease evaluation was done by a Forest Pest Management pathology crew in Block 9 of the Gray Fox Timber Sale, Warm Springs Indian Reservation (T. 7 S., R. 9 E., sec. 9). Bureau of Indian Affairs and Tribal foresters had observed substantial amounts of tree mortality and windthrow in this unit and suspected the presence of root diseases. They requested a survey to determine identity and incidence of diseases, quantify associated damage, and provide management recommendations for the next rotation. The block is slated for clearcutting in 1982.

METHODS

A systematic sampling method was used to survey the stand. Variable plots (BAF 40) were located on a 2X3 chain grid across the unit. A Spiegel-Relaskop was used to define plots. All trees in each plot were tallied, and the following information was recorded for each: species, DBH, height, general condition (live, dead, standing, down) and presence of disease and insect infestation. The root collar of each tree was exposed, two roots on opposite sides of the stem were excavated to a distance of 3 feet, and the butt and roots were examined for evidence of root diseases. Samples collected from stained portions of roots were taken to the laboratory and isolated on selective medium. Stems and crowns of all plot trees were examined for sporophores of decay fungi, dwarf mistletoe infections, and evidence of insect infestations. From the data collected in the variable plots, mean basal area, number of trees, and volume per acre were calculated by tree species, DBH class, and disease condition.

RESULTS AND DISCUSSION

The stand examined was composed predominantly of large, old Douglas-fir (*Pseudotsuga menziesii*) mixed with younger grand fir (*Abies grandis*) and western hemlock (*Tsuga heterophylla*). A few Pacific silver fir (*A. amabilis*), noble fir (*A. procera*), western white pine (*Pinus monticola*), and western larch (*Larix occidentalis*) were scattered through the stand. Average ages for a sample of 25 trees cored with an increment borer were 230 years for Douglas-fir, 136 years for grand fir, and 142 years for western hemlock.

Mean basal areas, numbers of trees, and cubic foot volumes per acre for the survey unit are summarized in Tables 1, 2, and 3. The stand was characterized by a relatively high average basal area and volume concentrated in a rather small number of stems. Dead trees accounted for 27 percent of the basal area, 19 percent of the stems, and 28 percent of the volume. Most mortality was caused by tree diseases. Losses associated with the various pathogens observed in the block are summarized in Tables 3, 4, and 5, and each is discussed in the following individual sections.

Laminated Root Rot - By far the most frequently encountered and damaging disease in the stand was laminated root rot, caused by the fungus, *Phellinus (Poria) weirii*. This disease was identified by its typical laminated decay that separates readily at the growth rings (Figure 1), the reddish, whiskery setal hyphae that appear between the sheets of rotted wood (Figure 2), and the grayish ectotrophic mycelia on root bark (Figure 3). Laminated root rot was found affecting 18 percent of the basal area, 13 percent of the stems, and 19 percent of the cubic foot volume on the unit, and was associated with 65 percent of all tree mortality. The disease was detected in 24 of 40 basal area plots (60%) distributed throughout the survey block (Figure 4). Douglas-fir and grand fir were the hosts affected.

Laminated root rot is a particularly dangerous disease because of its devastating effects on the host and because the causal agent is persistant on the site. The fungus can survive for long time periods (up to 50 years) in roots of old stumps, infecting new hosts that become established on the site via root contacts. Infection centers develop and increase in size due to subsequent spread from tree to tree along roots. Infection usually results in death or windthrow of susceptible hosts.

Recommended control for laminated root rot is to cut all susceptible hosts in infection centers and a 50-foot buffer around each, and (1) mechanically remove all inoculum (infected roots and stumps) with heavy equipment, or (2) leave inoculum but replant with immune, resistant, tolerant, or intermediately susceptible tree species that are adapted to the site. Mechanical removal of inoculum is effective and allows the manager to replant with any tree species desired, but it is very expensive, difficult on steep terrain, and may contribute to substantial soil damage. Tree species manipulation in disease centers is often a more viable control alternative.

On the Warm Springs Indian Reservation, tree species by decreasing degree of susceptibility are: immune - hardwoods; resistant - incense cedar, western redcedar, ponderosa pine; tolerant - western white pine, sugar pine, lodgepole pine; intermediately susceptible - western hemlock, western larch, noble fir, Engelmann spruce; highly susceptible - Douglas-fir, mountain hemlock, grand fir, Pacific silver fir. If only immune species are planted on an infected site and grown for a rotation (50 years or more), *P. weirii* will die out, and a highly susceptible species such as Douglas-fir could be grown in the following rotation with almost no likelihood of additional losses. If resistant or tolerant species are used, there should be much the same result, although there may be a small amount of infection and retention of the pathogen. If intermediate species are grown for a rotation, they should suffer little damage. However, many will be infected, a few may die, and the disease will be maintained on the site. Planting with Douglas-fir or another highly susceptible species in the subsequent rotation would prolong and intensify the problem.

Brown Cubical Root and Butt Rot - Brown cubical root and butt rot, caused by *Phaeolus (Polyporus) schweinitzii*, was encountered rather commonly in old Douglas-fir on the unit. The disease was identified by the typical reddish-brown, crumbly decay it causes in roots and butts of affected trees (especially obvious in those that have been windthrown or broken), and by the characteristic fruiting bodies that are produced on the ground within the root zone of diseased trees. Fruiting bodies are reddish brown, with a yellowish margin and a velvety surface when fresh (in fall) and dry up, darken, and closely resemble cow dung at other times of the year. Six percent of the basal area, 3 percent of the trees, and 8 percent of the volume were affected by brown cubical butt rot, and this disease was associated with 17 percent of the mortality observed in the surveyed block. The disease was found in 15 of the 40 basal area plots (37%) and was distributed as shown in Figure 6.

Phaeolus schweinitzii is a pathogen that mainly causes damage in old-growth stands. Means of spread are not completely understood, but apparently, both wind-borne spores that colonize wounds and mycelial growth between adjacent trees across root grafts and contacts are involved. Decay develops rather slowly, but after many years, can result in cull in the valuable butt log or contribute indirectly to death by making roots and stems susceptible to breakage. Though Douglas-fir is by far the most commonly encountered host in Oregon, most other conifers can be affected occasionally. Recommended control for brown cubical butt rot is to manage stands on a rotation of 150 years or less. Though some infection does occur in these younger stands, decay rarely develops sufficiently to cause significant damage.

Douglas-fir Dwarf Mistletoe - Dwarf mistletoe of Douglas-fir *(Arceuthobium douglasii)* was a third common pathogen in the survey block. Dwarf mistletoe was identified by its small, yellowish-green shoots that grow from swellings on host branches and by the large, bushy witches'-brooms formed in the crowns of infected trees. Douglas-fir dwarf mistletoe was found affecting 7 percent of the stems in the unit representing 19 percent of the basal area, and containing 21 percent of the volume. Though many of the infected trees were still alive, dwarf mistletoe was the only pathogen associated with 8 percent of the tree mortality. The disease occurred in 26 of the 40 basal area plots (65%) distributed throughout the entire stand (Figure 6).

The dwarf mistletoes are parasitic higher plants that are usually quite host specific. Douglas-fir dwarf mistletoe infects only Douglas-fir. Spread is by forcibly discharged seeds that are shot out from fruits on the mature female plant and fall into the crowns of other trees below the host tree. On the average, Douglas-fir dwarf mistletoe seeds are shot out a distance of 10 feet. At the most, they may travel 30 feet outward. Once a mistletoe seed lands on susceptible host foliage, its sticky coating allows it to slide down to the twig and adhere at the base of a needle. The seed then germinates and produces an infection peg that grows down into the host tissue. With time, the mistletoe plant develops both aerial shoots and a sinker system (comparable to a root system) incorporated within the host. The dwarf mistletoe obtains food and water from the host and, at the same time, causes abnormal growth in the tree, resulting in swellings and witches'-brooms. Ultimately, infections can cause tree distortion, top-kill, considerable growth loss, and, not uncommonly, tree death.

Recommended control for Douglas-fir dwarf mistletoe is to clearcut infected stands, thoroughly eliminating all infected Douglas-fir. The unit can then either be planted with a nonhost or with Douglas-fir again. If Douglas-fir is used, the boundary of the clearcut must be free of Douglas-fir dwarf mistletoe to prevent reinvasion.

Other Diseases - In addition to the major diseases mentioned, several others were encountered in the survey unit. These included stem rots caused by *Echinodontium tinctorium* on grand fir and *Phellinus (Fomes) pini* on Douglas-fir, root rots caused by *Armillaria mellea* and *Fomes annosus* on Douglas-fir, and white fir dwarf mistletoe *(Arceuthobium abietinum* f. sp. *concoloris)* on grand fir. Each of these was seen on only one tree, and none appeared to be causing significant damage. White pine blister rust, *(Cronartium ribicola)*, though occurring in nearby stands, was not observed in the survey unit.

Insect Pests - Fir engraver beetles *(Scolytus ventralis)* were found commonly in the survey unit infesting grand firs that were infected by *P. weirii*. Flatheaded and roundheaded borers (Buprestids and Cerambycids) were also common on root-diseased grand firs and Douglas-firs. All of these insects prefer stressed or low-vigor trees, and in the Gray Fox unit, appear to be playing a secondary role to laminated root rot.

Mountain pine beetles (*Dendroctonus ponderosae*) were found infesting 14 percent of the few western white pines on the survey unit. These trees accounted for 33 percent of the white pine basal area and 36 percent of the volume. Mountain pine beetles are aggressive attackers of large diameter western white pines (DBH >16 inches) growing in dense stands (basal area >150 $ft.^2$ per acre). Mountain pine beetle damage to white pine can be prevented by using rotations of 120 years or less and thinning stands to prevent overstocking.

MANAGEMENT RECOMMENDATIONS

Our survey reveals that the stand on the Gray Fox unit is suffering particularly severe damage from laminated root rot. Although the area we surveyed was small, (24 acres), per acre loss figures are among the highest that we have seen in any root-diseased grand fir-Douglas-fir stand in eastern Oregon. If not treated, laminated root rot will cause at least as much damage or may even intensify in the next rotation. The disease is distributed over virtually the whole surveyed area, so any treatment applied will have to be all inclusive. In addition to root rot, the stand also has high levels of Douglas-fir dwarf mistletoe and brown cubical root and butt rot. Treatment of these diseases can be integrated with root rot control. Finally, if western white pine is planted in the next rotation, white pine blister rust and mountain pine beetles may be potentially serious problems. This species will require special treatment. From a pest management point of view, we make the following specific management suggestions for the unit:

1. Clearcut the stand as planned. Be sure to remove or destroy in site preparation all grand fir and Douglas-fir on the site.

2. Replant the unit with tree species that are both (a) adapted to the site, and (b) immune, resistant, tolerant, or at least intermediately susceptible to laminated root rot. We believe that the best trees available for the specific area are western white pine, noble fir, western hemlock, and western larch. We would suggest planting several of these species in a mix. Grand fir and Douglas-fir should not be planted on the unit, and natural regeneration of these species should be discouraged. Any western white pine stock used in planting the site should be blister rust resistant.

3. When the stand is thinned precommercially and commercially, discriminate against naturally regenerated grand fir and Douglas-fir if any has become established. Try to avoid wounding leave trees of any species, but especially western hemlock and noble fir. Thin the portions of the stand containing western white pine to such a level that basal area will not exceed 150 $ft.^2$ per acre by the time of the following entry.

4. Keep length of the entire rotation to 120 years or less.

5. Continue the same management regime in subsequent rotations on the site.

Prepared by: Donald J. Goheen
Donald J. Goheen, Plant Pathologist — 2/23/82 Date

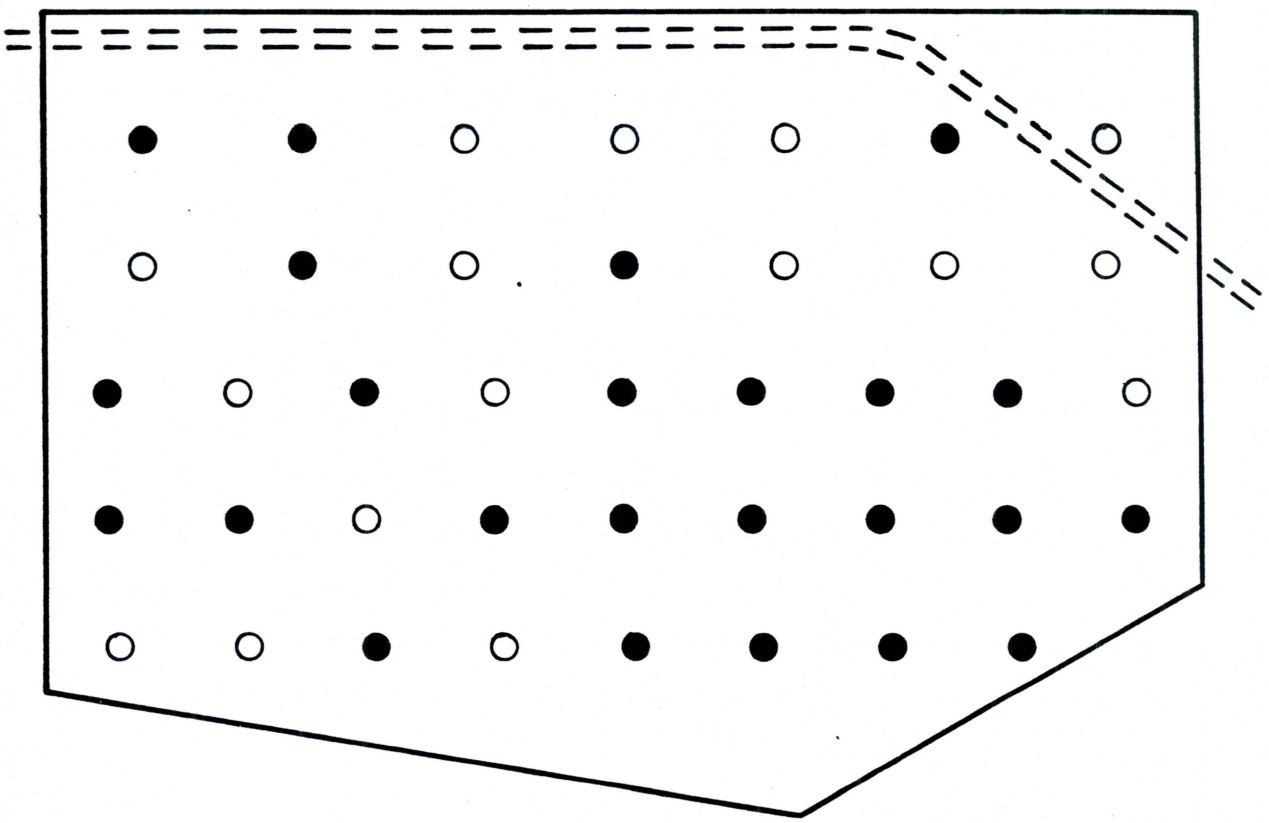
Reviewed by James S. Hadfield
James S. Hadfield, Supervisory Pathologist — 2/17/82 Date

Approved by: Paul E. Buffam
Paul E. Buffam, Director, FPM — 2/17/82 Date

Figure 1. Typical laminated decay caused by *Phellinus weirii*.

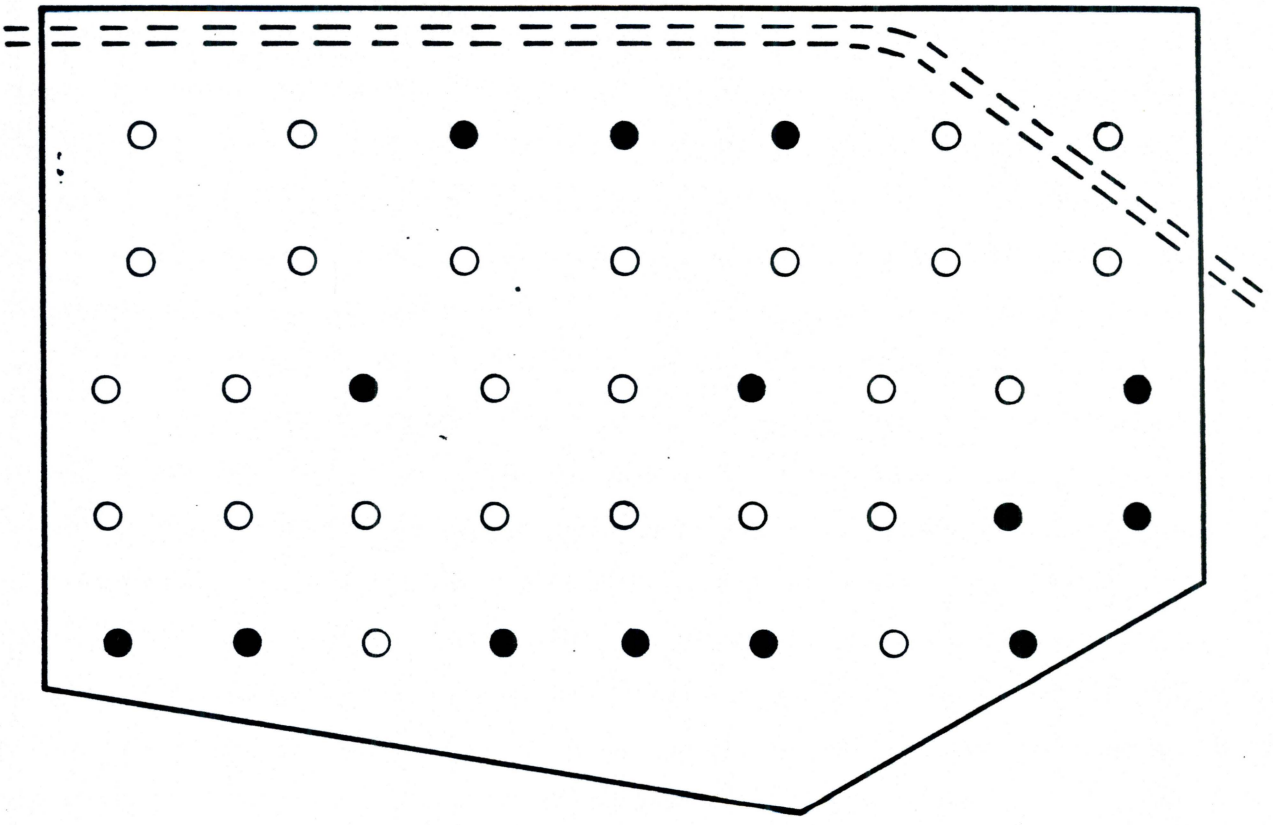
Figure 2. Setal hyphae of *Phellinus weirii* formed between layers of rotted wood.

Figure 3. Ectotrophic mycelia of *Phellinus weirii* on excavated Douglas-fir roots.



6 INCHES = 1/4 MILE

Figure 4. Distribution of laminated root rot (black plots) in Block 9, Gray Fox Sale.



6 INCHES = 1/4 MILE

Figure 5. Distribution of brown cubical root and butt rot (black plots) in Block 9, Gray Fox Sale.

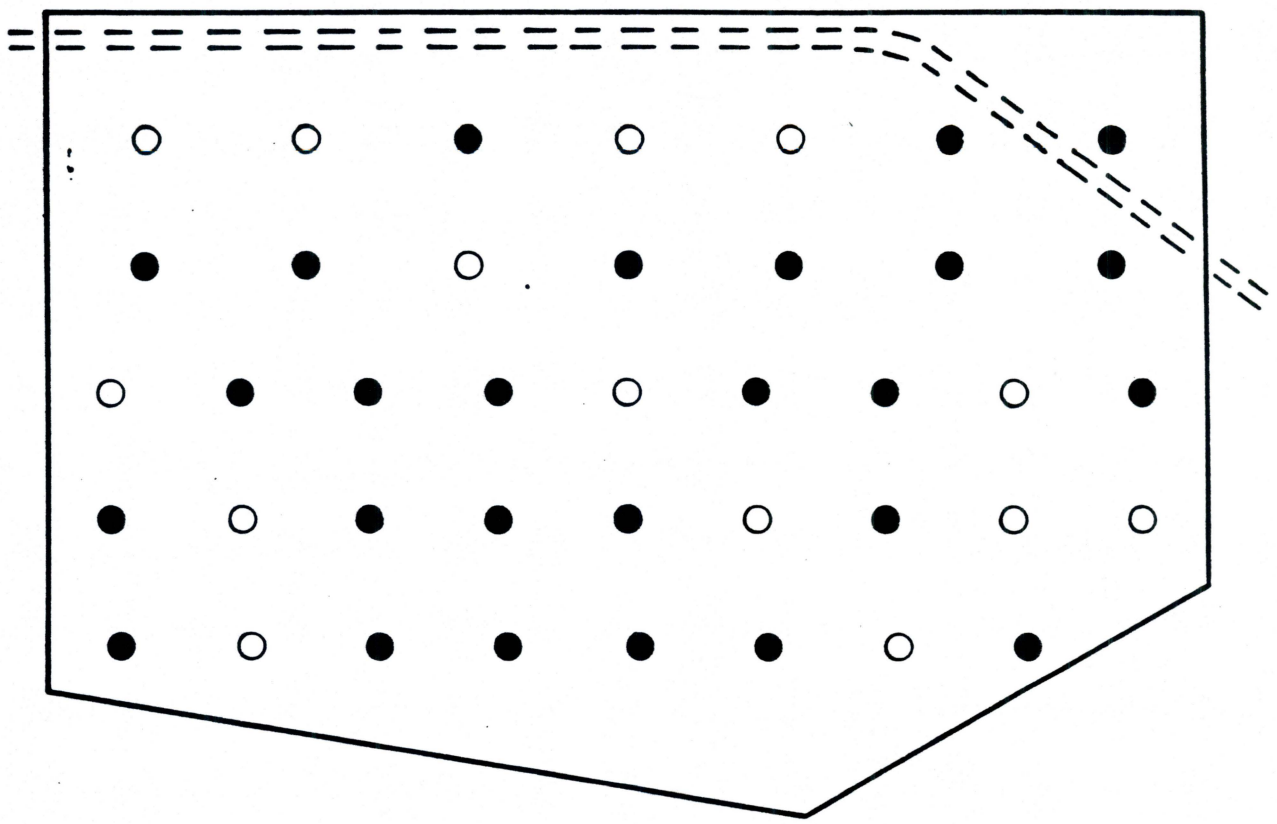


Figure 6. Distribution of Douglas-fir dwarf mistletoe (black plots) in Block 9, Gray Fox Sale.

Table 1.--Mean basal area per acre ($ft.^2$) by tree species, condition, and diameter class, Gray Fox Sale.

DBH	Douglas-fir		Grand fir		Western Hemlock		Pacific Silver and Noble Fir		Western White Pine		Western Larch	
Class	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
8	1.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	4.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	4.0	1.0	14.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	12.0	3.0	2.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
16	3.0	2.0	12.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	2.0	2.0	6.0	0.0	4.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0
20	1.0	4.0	8.0	1.0	3.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0
22	1.0	1.0	4.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
24	0.0	2.0	3.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	3.0	9.0	3.0	0.0	4.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0
28	4.0	11.0	0.0	1.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	4.0	8.0	2.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
32	11.0	4.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	6.0	7.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	7.0	2.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
38	15.0	8.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	12.0	6.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	8.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	13.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
46	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	4.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	2.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
52	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total All Classes	116.0	74.0	78.0	14.0	41.0	0.0	4.0	1.0	2.0	1.0	1.0	1.0

Table 2.--Mean number of trees per acre by species, condition, and diameter class, Gray Fox Sale.

DBH	Douglas-fir		Grand fir		Western Hemlock		Pacific Silver and Noble Fir		Western White Pine		Western Larch	
Class	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
8	2.86	0.00	20.05	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	7.33	3.67	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00
12	5.09	1.27	17.82	1.27	2.54	0.0	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	11.22	1.87	1.87	0.0	0.99	0.00	0.00	0.00	0.00	0.00
16	2.15	1.44	8.59	0.72	1.43	0.0	0.00	0.00	0.00	0.00	0.00	0.00
18	1.14	1.14	3.40	0.00	2.26	0.0	0.00	0.00	0.57	0.00	0.00	0.00
20	0.46	1.84	3.67	0.92	1.37	0.0	0.92	0.00	0.00	0.00	0.00	0.00
22	0.38	0.38	1.51	0.00	2.65	0.0	0.00	0.00	0.00	0.00	0.00	0.38
24	0.00	0.64	0.96	0.00	2.23	0.0	0.00	0.00	0.00	0.00	0.00	0.00
26	0.81	2.43	0.81	0.00	1.08	0.0	0.00	0.00	0.27	0.00	0.00	0.00
28	0.93	2.56	0.00	0.23	1.64	0.0	0.00	0.00	0.00	0.00	0.00	0.00
30	0.80	1.61	0.41	0.00	0.40	0.0	0.00	0.00	0.00	0.00	0.20	0.00
32	1.96	0.72	0.00	0.00	0.18	0.0	0.00	0.00	0.00	0.00	0.00	0.00
34	0.89	1.05	0.00	0.16	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00
36	0.99	0.70	0.00	0.28	0.00	0.0	0.00	0.00	0.00	0.14	0.00	0.00
38	1.91	1.03	0.13	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00
40	1.37	0.66	0.11	0.11	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00
42	0.82	0.40	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00
44	1.19	0.09	0.09	0.09	0.00	0.0	0.00	0.09	0.00	0.00	0.00	0.00
46	0.50	0.00	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00
48	0.32	0.08	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00
50	0.14	0.07	0.00	0.00	0.00	0.0	0.07	0.00	0.00	0.00	0.00	0.00
52	0.26	0.00	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00
54	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00
56	0.12	0.00	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00
58	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00
60	0.05	0.00	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00
Total All Classes	25.14	18.11	76.1	9.32	17.65	0.0	1.98	0.09	0.84	0.14	0.20	0.38

Table 3.--Mean volume per acre ($ft.^3$) by species, condition, and diameter class, Gray Fox Sale.

DBH Class	Douglas-fir		Grand fir		Western Hemlock		Pacific Silver & Noble fir		Western White Pine		Western Larch	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
8	7.0	00.0	110.3	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0
10	00.0	00.0	93.8	47.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0
12	115.0	28.1	384.9	27.4	46.4	00.0	00.0	00.0	00.0	00.0	00.0	00.0
14	00.0	00.0	398.3	66.4	60.4	00.0	35.2	00.0	00.0	00.0	00.0	00.0
16	71.8	48.0	424.3	35.6	66.4	00.0	00.0	00.0	00.0	00.0	00.0	00.0
18	79.1	79.1	240.4	00.0	143.1	00.0	00.0	00.0	39.6	00.0	00.0	00.0
20	42.7	170.8	354.2	88.8	117.4	00.0	88.8	00.0	00.0	00.0	00.0	00.0
22	42.9	42.9	174.0	00.0	286.7	00.0	00.0	00.0	00.0	00.0	00.0	42.9
24	00.0	85.0	127.8	00.0	284.3	00.0	00.0	00.0	00.0	00.0	00.0	00.0
26	125.6	376.7	149.9	00.0	179.8	00.0	00.0	00.0	41.85	00.0	00.0	00.0
28	197.0	542.2	00.0	52.9	299.6	00.0	00.0	00.0	00.0	00.0	00.0	00.0
30	184.4	371.1	112.8	00.0	88.8	00.0	00.0	00.0	00.0	00.0	46.1	00.0
32	572.9	210.5	00.0	00.0	47.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0
34	292.5	345.0	00.0	350.1	00.0	00.0	00.0	00.0	00.0	46.0	00.0	00.0
36	346.3	244.9	00.0	114.6	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0
38	748.9	403.9	59.1	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0
40	553.9	266.8	50.9	50.9	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0
42	470.9	229.7	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0
44	666.4	50.4	43.1	43.1	00.0	00.0	00.0	43.1	00.0	00.0	00.0	00.0
46	364.6	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0
48	239.8	59.9	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0
50	107.7	53.9	00.0	00.0	00.0	00.0	49.0	00.0	00.0	00.0	00.0	00.0
52	205.6	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0
54	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0
56	99.7	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0
58	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0
60	435.3	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0
Totals	5970.0	3112.4	2723.8	876.8	1619.9	00.0	173.0	43.1	81.45	46.0	46.1	42.9

Table 4.--Mean basal area per acre ($ft.^2$) by disease, condition, and diameter class, Gray Fox Sale.

DBH	Living Diseased Trees with: Phellinus weirii	Dwarf Mistletoe	Phellinus weirii & Dwarf Mistletoe	Dead Trees with Phellinus weirii	Dwarf Mistletoe	P. weirii & Dwarf Mistletoe	Polyporus schweinitzii
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	2.0	0.0	0.0	0.0
12	0.0	0.0	0.0	2.0	0.0	0.0	0.0
14	1.0	0.0	0.0	2.0	0.0	0.0	0.0
16	0.0	1.0	0.0	2.0	0.0	0.0	0.0
18	0.0	1.0	0.0	0.0	1.0	0.0	1.0
20	0.0	0.0	0.0	3.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	1.0	0.0	1.0
24	1.0	0.0	0.0	2.0	0.0	0.0	0.0
26	1.0	1.0	0.0	1.0	0.0	0.0	7.0
28	0.0	1.0	0.0	7.0	0.0	2.0	2.0
30	1.0	4.0	0.0	5.0	0.0	0.0	2.0
32	0.0	5.0	0.0	2.0	0.0	0.0	0.0
34	0.0	3.0	0.0	5.0	0.0	0.0	2.0
36	0.0	3.0	0.0	3.0	0.0	1.0	0.0
38	0.0	7.0	0.0	5.0	0.0	0.0	2.0
40	0.0	9.0	0.0	3.0	0.0	1.0	2.0
42	0.0	1.0	0.0	1.0	1.0	1.0	1.0
44	0.0	7.0	1.0	1.0	1.0	1.0	0.0
46	0.0	2.0	1.0	0.0	0.0	0.0	0.0
48	0.0	2.0	0.0	1.0	0.0	0.0	0.0
50	0.0	1.0	0.0	1.0	0.0	0.0	0.0
52	0.0	1.0	0.0	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	0.0	1.0	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total All Classes	4.0	50.0	2.0	48.0	5.0	6.0	20.0

Table 5.--Mean number of trees per acre by disease, condition, and diameter class, Gray Fox Sale.

DBH	Living Diseased Trees with: Phellinus weirii	Dwarf Mistletoe	Phellinus weirii & Dwarf Mistletoe	Dead Trees with Phellinus weirii	Dwarf Mistletoe	P. weirii & Dwarf Mistletoe	Polyporus schweinitzii
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	3.67	0.00	0.00	0.00
12	0.00	0.00	0.00	2.55	0.00	0.00	0.00
14	0.93	0.00	0.00	1.87	0.00	0.00	0.00
16	0.00	0.72	0.00	1.43	0.00	0.00	0.00
18	0.00	0.57	0.00	0.00	0.57	0.00	0.57
20	0.00	0.00	0.00	1.37	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.38	0.00	0.38
24	0.32	0.00	0.00	0.64	0.00	0.00	0.00
26	0.27	0.27	0.00	0.27	0.00	0.00	1.91
28	0.00	0.23	0.00	1.64	0.00	0.47	0.48
30	0.20	0.81	0.00	1.02	0.00	0.00	0.41
32	0.00	0.89	0.00	0.36	0.00	0.00	0.00
34	0.00	0.47	0.00	0.79	0.00	0.00	0.32
36	0.00	0.42	0.00	0.42	0.00	0.14	0.00
38	0.00	0.89	0.00	0.63	0.00	0.00	0.25
40	0.00	1.03	0.00	0.34	0.00	0.11	0.22
42	0.00	0.10	0.00	0.10	0.10	0.10	0.10
44	0.00	0.66	0.09	0.09	0.09	0.09	0.00
46	0.00	0.17	0.09	0.00	0.00	0.00	0.00
48	0.00	0.16	0.00	0.08	0.00	0.00	0.00
50	0.00	0.07	0.00	0.07	0.00	0.00	0.00
52	0.00	0.07	0.00	0.00	0.00	0.00	0.00
54	0.00	0.00	0.00	0.00	0.00	0.00	0.00
56	0.00	0.06	0.00	0.00	0.00	0.00	0.00
58	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total All Classes	1.72	7.59	0.18	17.34	1.32	0.91	4.64

Table 6.--Mean volume per acre ($ft.^3$) by disease, condition, and diameter class, Gray Fox Sale.

	Living Diseased Trees with:			Dead Trees with:			
DBH	Phellinus weirii	Dwarf Mistletoe	Phellinus weirii & Dwarf Mistletoe	Phellinus weirii	Dwarf Mistletoe	P. weirii & Dwarf Mistletoe	Polyporus schweinitzii
8	00.0	00.0	00.0	00.0	00.0	00.0	00.0
10	00.0	00.0	00.0	47.0	00.0	00.0	00.0
12	00.0	00.0	00.0	56.3	00.0	00.0	00.0
14	33.0	00.0	00.0	66.4	00.0	00.0	00.0
16	00.0	24.0	00.0	59.2	00.0	00.0	00.0
18	00.0	39.5	00.0	0.00	39.5	00.0	39.5
20	00.0	00.0	00.0	129.6	00.0	00.0	00.0
22	00.0	00.0	00.0	00.0	42.9	00.0	42.9
24	42.5	00.0	00.0	85.0	00.0	00.0	00.0
26	45.9	41.8	00.0	45.9	00.0	00.0	296.0
28	00.0	48.7	00.0	362.3	00.0	103.8	404.5
30	50.6	186.7	00.0	257.8	00.0	00.0	94.5
32	00.0	260.1	00.0	110.2	00.0	00.0	00.0
34	00.0	154.4	00.0	259.6	00.0	00.0	105.1
36	00.0	146.9	00.0	146.9	00.0	49.0	00.0
38	00.0	349.0	00.0	266.6	00.0	00.0	98.0
40	00.0	416.4	00.0	137.5	00.0	44.5	88.9
42	00.0	57.4	00.0	57.43	57.4	57.4	57.4
44	00.0	369.6	46.7	46.7	50.4	46.7	00.0
46	00.0	124.0	65.6	00.0	00.0	00.0	00.0
48	00.0	119.9	00.0	59.9	00.0	00.0	00.0
50	00.0	53.8	00.0	51.4	00.0	00.0	00.0
52	00.0	55.3	00.0	00.0	00.0	00.0	00.0
54	00.0	00.0	00.0	00.0	00.0	00.0	00.0
56	00.0	49.8	00.0	00.0	00.0	00.0	00.0
58	00.0	00.0	00.0	00.0	00.0	00.0	00.0
60	00.0	00.0	00.0	00.0	00.0	00.0	00.0
Total All Classes	172.0	2,497.3	112.3	2,245.7	190.2	301.4	1,226.8